REMARKS

Claims 8-16 and 21-31 are presently pending. Claims 14-16, 22-24 and 28-31 have been withdrawn from consideration. Claims 8-13, 21 and 25-27 have been rejected. No claims have been allowed, canceled, amended or added.

I. Priority Claim under 35 U.S.C. § 120

Page 6 of the Office Action states, "There is no priority claim under 35 USC sec. 120." Applicants respectfully submit that this statement may be in error, and note that a claim for priority under 35 U.S.C. § 120 was properly made at the time of filing to co-pending U.S. Patent Application No. 10/224,291. This priority claim is reflected on 1) the Application Data Sheet as filed; 2) the Declaration and Power of Attorney signed by all inventors, and 3) the first paragraph of the written description as filed.

II. Withdrawn Claims

Claims 14-16, 22-24 and 28-31 have been withdrawn from further consideration as being drawn to non-elected groups. Applicants note that claims 14-16 and 22-24 all depend directly or indirectly from independent claim 13, such that these withdrawn claims should be reinstated and allowed if claim 13 becomes allowed. Applicants also note that claims 28-31 all depend directly or indirectly from independent claim 8, such that these withdrawn claims should be reinstated and allowed if claim 8 becomes allowed.

III. Specification

The prior amendments filed by Applicants on July 5, 2005, have been objected to under 35 U.S.C. § 132(a) because they are alleged to introduce new matter into the disclosure. Applicants respectfully disagree, and submit that all prior amendments are

supported by the original written description, figures and claims as filed. The Office Action identifies the following added claim elements as alleged new matter:

> For claim 1 [sic, 8]:
> the resulting mid-level wetting angles remain sufficiently high such that said mid-level junctions do not become the primary location for solder joint failure, and the resulting first wetting angles are at least approximately 40 degrees
>
> For claim 26:
> first wetting angles and mid-level wetting angles that are greater than about 50 degrees
>
> For claim 27:
> first wetting angles and mid-level wetting angles that are equal to or greater than about 60 degrees

Applicants respectfully submit that these amendments of claims 8, 26 and 27 do not introduce new matter, and for support point to paragraphs 0037 through 0041, FIGS. 6, 7A and 7B and claims 5 and 14 of the original application as filed. In particular, paragraph 0039 explains:

> FIG. 7B shows a die-solder joint-substrate combination 300 that typically results when a support coating having a height of greater than about 70 percent of the overall solder bump height is formed on the active surface of the wafer. . . . *the mid-level angle 335 has been reduced substantially, such that it now becomes the primary location for solder joint cracking and shearing due to temperature cycle failure*. It thus becomes apparent that any advantageous use of a support coating to strengthen the solder joint connections must strike a balance between optimizing the solder joint to die wetting angle and optimizing the mid-level angle corresponding to the height of the support coating.

(emphasis added). The emphasized passage relates to an undesirable result that is found in items having a support coating height that is too high (i.e., outside the height ranges claimed). Preferable resultant wetting angles are also described at other locations, as noted, such that these claim amendments overall are supported by the original disclosure.

IV. Claim objections

Claims 8, 26 and 27 are objected to due to informalities. Applicants assume that these objections are being made with respect to the terminology "at least approximately 40

degrees," "greater that about 50 degrees," and "greater than about 60 degrees." Applicants respectfully submit that this claim language fairly reflects that which is being claimed, and note that the use of relative terminology and terms such as "about" in claims is permitted. *See, e.g.*, MPEP § 2173.05(b). It is respectfully submitted that this particular claim language is not indefinite when read in the context of the full claims and accompanying specification.

V. Claim Rejections under 35 U.S.C. § 112

Claims 8-12 and 25-27 stand rejected under 35 U.S.C. § 112, second paragraph. In particular, the Office Action states:

> claim 8 recites the broad recitation of the range for the support coating's height such that the upper surface of the support coating meets the solder bumps, and the claim also recites that the height of the support coating is from about 20-70 percent of the pre-reflow height of the solder bumps which is the narrower statement of the range/limitation.

Applicants respectfully traverse these rejections and submit that these rejections reflect a fundamental misreading of the language of claim 8.

Claim 8 specifically recites, "a support coating formed . . . *such that mid-level wetting angles are formed at mid-level junctions where the upper surface of said support coating meets said solder bumps*, . . . wherein the height of said support coating is from about 20 percent to about 70 percent of the pre-reflow height of said solder bumps" (emphases added). Applicants respectfully submit that the portion of claim 8 italicized above does *not* define or suggest any support coating height, much less a "broad recitation of the range for the support coating's height," as asserted by the Office Action. Rather, this italicized portion only serves to define where mid-level junctions and wetting angles are formed, which are "where the upper surface of said support coating meets said solder bumps." Applicants note that such a meeting location of upper surface support coating to solder bump is independent of the height of the support coating (providing, of course, that the support coating height does not exceed

the solder bump height). One example of such a mid-level wetting angle is illustrated as item 135 in FIG. 6. The portion of claim 8 that is underlined above recites the only specification for support coating height in claim 8, which is a range from about 20 percent to about 70 percent of the pre-reflow height of the solder bumps. As an example, should the support coating height actually be at 20 percent of the pre-reflow height of the solder bumps in a given application, then the mid-level wetting angles will be formed at mid-level junctions that are at 20 percent of the pre-reflow height of the solder bumps (i.e., where the upper surface of the support coating meets the solder bumps).

Because none of rejected claims 8-12 and 25-27 set forth any conflicting broad and narrow ranges of support coat height within the same claim, the pending rejections under 35 U.S.C. § 112, second paragraph cannot stand. Accordingly, Applicants respectfully request withdrawal of these rejections.

VI. Claim Rejections under 35 U.S.C. § 103

Claims 8-13, 21, 25-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Buchwalter et al. (2002/0109228 A1) ("Buchwalter") alone. In particular, the Office Action states, "it would have been obvious . . . to modify the invention of Buchwalter with a specific range for the support coating's height," and also, "that the specification contains no disclosure of the critical nature of the claimed dimensions." Applicants respectfully traverse these § 103 rejections, and in so doing incorporate all arguments set forth in the prior amendment filed by Applicants on July 5, 2005.

Criticality of Claimed Height

As was done in this prior amendment, Applicants again note that significant portions of the written description and figures as filed are devoted toward the criticality of providing a support coating having a specific height range with respect to the solder bumps. In particular,

paragraphs 0039 through 0041 and FIGS. 5A through 7B of the application as originally filed directly address the need for specific height ranges for the support coating. These passages and figures disclose the importance of such height ranges and the undesirability of support coating heights outside of these ranges. For example, paragraph 0039 begins:

> **It should be noted, however, that the height of the support layer relative to the solder bump and the amount of solder paste used on the substrate must be reasonably controlled to have the best results.**

Paragraphs 0039 and 0040 continue by discussing the problems inherent to support coatings having a height of less 20 percent and those having a height of greater than 70 percent of the overall solder bump height, namely that "very little solder bump collapse has been prevented" when the support coating height is less than about 20 percent, and that "the mid-level angle 335 has been reduced substantially, such that it now becomes the primary location for solder joint [failure]" when the height is greater than about 70 percent. Paragraph 0041 then states:

> **Experimentation has determined that final heights for the support coating that go lower than about 20 percent and higher than about 70 percent of the original solder bump height result in solder joints that tend to be progressively weaker as the percentage extends from this range. . . . [Beneficial] results certainly occur when the final height of the support coating falls between about 20 percent and about 70 percent of the original solder bump height. More preferably, the final height of the support coating should be at about 40 to 60 percent of the original height of the solder bumps, and even more preferably, the support coating height should be at about 48 to 52 percent of the original height of the solder bumps. It is thought that the ideal final height of the support coating is about 50 percent of the original solder bump height.**

Applicants respectfully submit that the foregoing passages and accompanying figures are more than adequate to establish criticality of the claimed height ranges, and respectfully request clarification of the statement that the present "specification contains no disclosure of the critical nature of the claimed dimensions."

Failure of Buchwalter to Suggest Claimed Height

As noted previously, Buchwalter never teaches or suggests a support coating having a height of 70 percent or less of its solder bump height. In fact, Buchwalter teaches only of

underfill layers having heights *greater* than 70 percent of its solder bump height, and in many cases greater than 100 percent of its solder bump height. In both embodiments, Buchwalter teaches a "bilayer wafer level underfill," whereby two separate polymeric layers are formed on a surface of a semiconductor wafer in such a way that its solder bumps are *entirely covered* (Buchwalter, paragraphs 0013-0018; FIGS. 1F and 2D). Thus, the combined height of the two polymeric underfill layers is greater than 100% of the solder bump heights in either embodiment. In both embodiments of Buchwalter, the top layer of this bilayer underfill is diffused during bonding only to expose an upper surface of each solder bump, whereby a full and complete underfill is created; i.e., its "solder joints are completely surrounded and reinforced by the underfill" (Buchwalter, end of paragraph 0049).

Applicants reiterate that even under a worst case scenario, the height of the first layer of Buchwalter's bilayer underfill cannot be less than 71.4% of the solder bump height, and again submit that any suggestion that it would be obvious to lower the height of the underfill layer of Buchwalter would fly in the face of that which is taught by the reference. A prior art reference must be considered in its entirety, including portions that would lead away from the claimed invention. MPEP § 2141.02. Buchwalter teaches of underfill layers that are fully applied at the wafer level only, such that *only a surface* of a solder bump is to be exposed for bonding purposes. In both of its embodiments, Buchwalter teaches that its solder bumps are fully covered by its pre-applied underfill layers, and that the top surfaces of its solder bumps do not even become exposed until the bonding process is underway. As such, any alleged "optimization and experimentation with a specific range for the height of the support coating relative to the bumps" would be inapplicable to Buchwalter based on its own teachings.

Further, the second pre-applied underfill layer in Buchwalter is intended only to be a thin and dispersible adhesive layer, such that there is no motivation or incentive to increase the thickness of this layer. Thus, it would not be obvious to modify Buchwalter to specify a

support coating height that is at about or less than 70 percent of the height of the solder bumps. Because each of the pending claims requires that the "the height of said support coating is from about 20 percent to about 70 percent of the pre-reflow height of said solder bumps," all claims are patentable over Buchwalter for at least this reason.

For at least the foregoing reasons, it is respectfully submitted that none of the pending claims are rendered as obvious by Buchwalter. Accordingly, Applicants respectfully request that the pending obviousness rejections be withdrawn.

CONCLUSION

Applicants respectfully submit that all claims are in proper form and condition for patentability, and thus request a Notification of Allowance to that effect. It is believed that no fees are due at this time. If any fees are due in connection with this Response to Office Action or for this application in general, however, then the Commissioner is hereby authorized to charge such fees to Deposit Account No. 50-0388, referencing Docket No. NSC1P131X3. If there are any questions or issues remaining, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number listed below.

Respectfully Submitted,
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